



**Changkat Changi Secondary School**

# **UNIT 8**

# **TRANSFER OF THERMAL ENERGY**

Name: \_\_\_\_\_

Class: \_\_\_\_\_

Date: \_\_\_\_\_

## CONTENT PAGE

Date	Notes/Worksheets	Marks	Remarks
	Notes 8.1		
	Notes 8.2		
	Notes 8.3		
	Notes 8.4		
	Worksheet 8.1		
	Worksheet 8.2		
	Worksheet 8.3		
	Worksheet 8.4		

## NOTES 8.1

### LESSON OBJECTIVES

At the end of the lesson, you will be able to:

- Show understanding that thermal energy is transferred from a region of higher temperature to a region of lower temperature.
- Describe how energy transfer occurs in solids
- Explain applications of conductions

### Transfer of Thermal Energy

Earlier on, we have seen how gas molecules move faster when temperature is increased. This is due to the transfer of thermal energy which takes place only when there is a \_\_\_\_\_ in temperature.

In this unit, we will discuss the means of thermal energy transfer and how we use them in everyday applications.

### Try this out!

Prepare two basins of water labeled P,Q and Q at 10°C, 37°C and 60°C respectively. Place your right hand in basin P and your left hand into the R. How would your hands feel? Explain.

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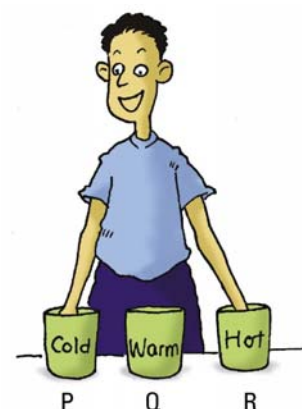
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Now remove both hands, dry them with a cloth and wait for the cold or hot effects to subside before putting one hand into Q. How would your hand feel now? Explain.

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**Conclude:** Thermal energy always flow from a region of \_\_\_\_\_ temperature to a region of \_\_\_\_\_temperature.

### How is thermal energy transferred?

Thermal energy is transferred by any of these three processes, \_\_\_\_\_.

## Conduction

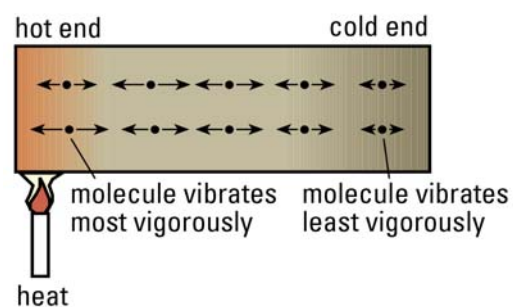
Conduction is \_\_\_\_\_.

In general, good conductors of heat are metals such as copper, silver and iron. Poor conductors, also known as good insulators, include materials such as glass, plastic, wood.

### How does conduction take place in solid and metals ?

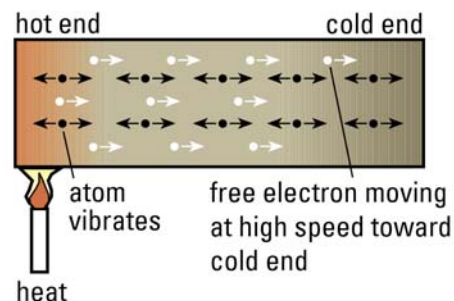
In solids:

Molecules at hot end vibrate vigorously when heated.



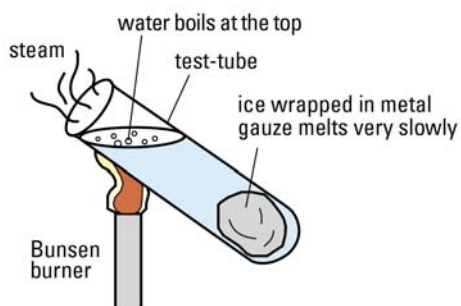
In metals:

Molecules at hot end vibrate vigorously when heated. Free electrons in metals also gain thermal energy and move.



### Do liquids and gases conduct heat?

Observe the following experiment



While the water is heated and shown to be boiling, the ice to the other end melts slowly. What can you say about liquid as a conductor? Explain.

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## Uses of Good and Bad conductors

Can you explain how the materials used in the following applications reduce or improve heat transfer by conduction?

1. Kettle



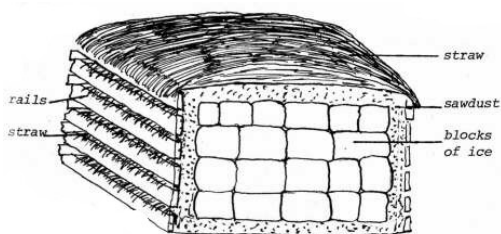
2. Sauce pan



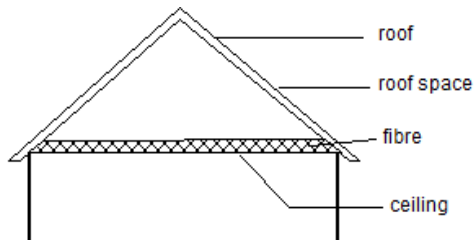
3. Winter jacket



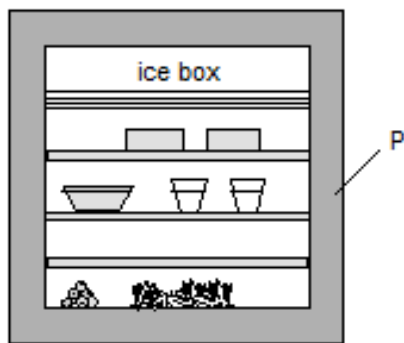
4. Using sawdust and straw to prevent ice from melting



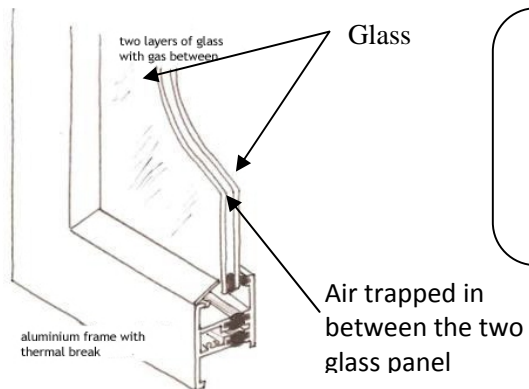
## 5. Roof Insulations



## 5. Polystyrene used in walls of refrigerators



## 6. Double glazing of windows in cold countries



During cold weather, birds are seen to be fluffing their feathers to stay warm. Why?

## NOTES 8.2

### LESSON OBJECTIVES

At the end of the lesson, you will be able to:

- Describe how energy transfer occurs in fluids
- Explain applications of convection

### Convection

In conduction, we have seen that solid molecules transfer heat by vibration about their fixed positions and passing energy to the neighbouring molecules. For liquid and gases, the molecules can move from one place to another, hence, another mode of heat transfer known as convection takes place.

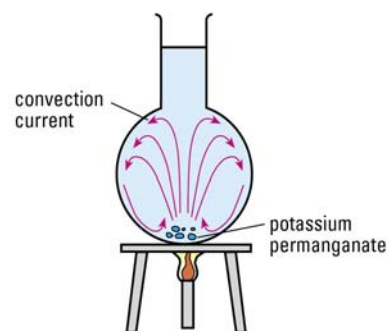
Convection is the \_\_\_\_\_.

### Observe this!

A few potassium permanganate is dripped into a flask/beaker filled with water. The flask/beaker is then heated gently just below the crystals. What do you see?

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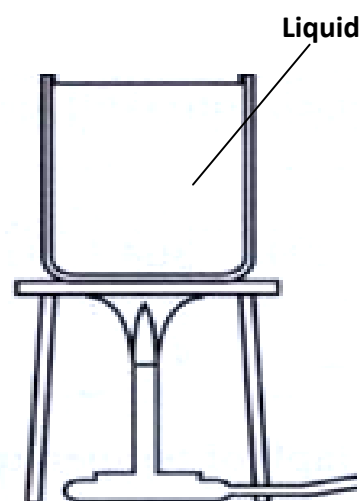
### Convection in Liquids (water)

When water at the bottom of the flask/beaker is heated, it expands.

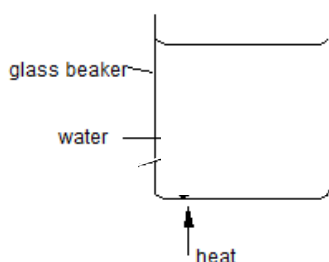
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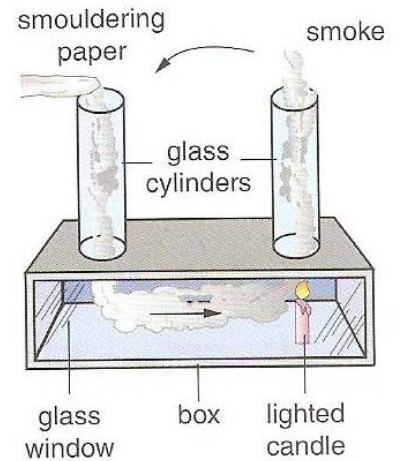
**Check! Draw how water currents will move when heated as shown below.**



## Convection in gases (air)

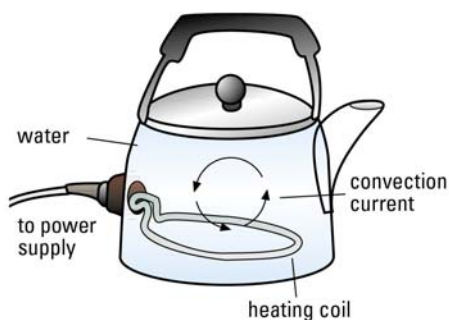
A simple experiment to show convection currents in air can be done using the apparatus below. Using your understanding of convection in liquids, can you explain why air will be drawn into the box?

When air above the candle is heated up, it expands.



## Applications involving convection

- a. Electric kettle ( convection involving water )



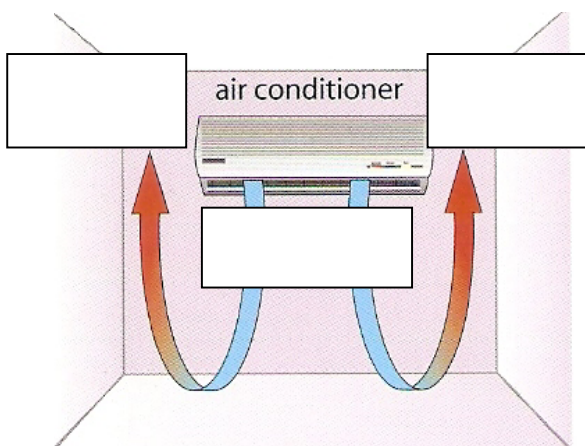
Explain why the heating coil is not placed near the top of the kettle?

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- b. Air Conditioner (convection involving air)



Fill in the missing labels and explain why air conditioners are usually positioned high in a room.

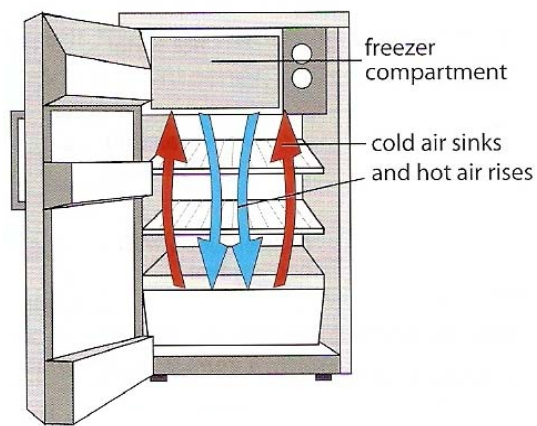
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### c. Refrigerators

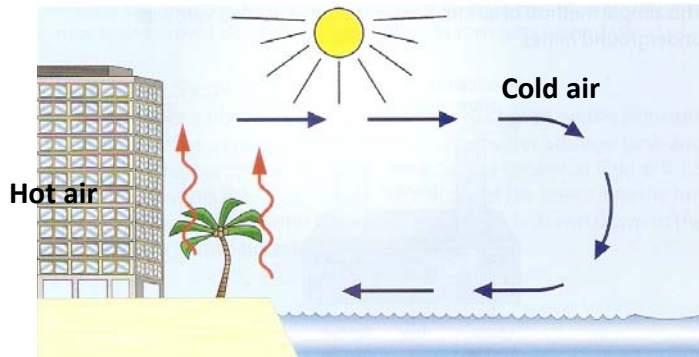


### d. Chimneys build in houses

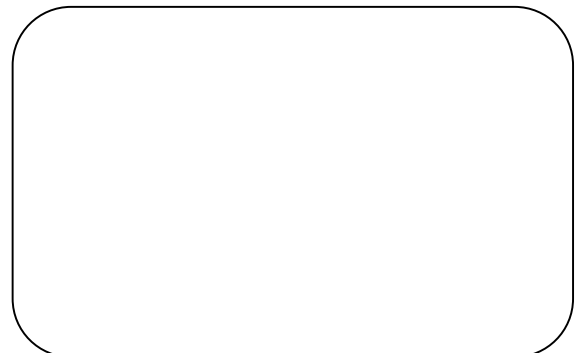
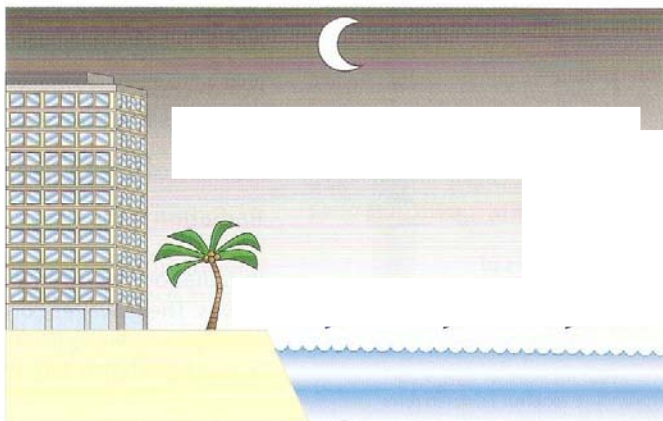


**Think!**

In the day, if we visit the costal areas such as the beach, we will experience a strong breeze coming from the sea. This is because during the day, the sun heats up the land much faster than the sea. Hence, air above the land gains heat faster and expands. The expanded hot air, being less dense, rises above the land. Cooler air above the sea is then drawn towards the land to fill up the gap, thus, creating what is known as **Sea Breeze**.



What do you think happens at night? Draw on the diagram to show how the air movement takes place and explain.



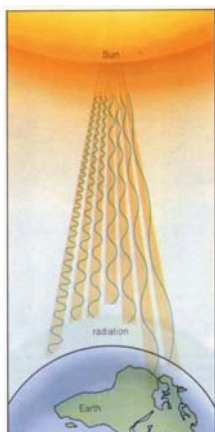
## NOTES 8.3

### LESSON OBJECTIVES

At the end of the lesson, you will be able to:

- Explain energy transfer of a body by radiation.
- State factors affecting the rate of energy transfer by radiation.
- Explain applications of radiation.

### Radiation



Heat energy from the sun reaches us in the form of energy carrying waves known as Infra-red waves. This form of heat transfer is known as radiation. Since the infrared radiation travels through vacuum to us, radiation does not require any \_\_\_\_\_ for heat transfer.

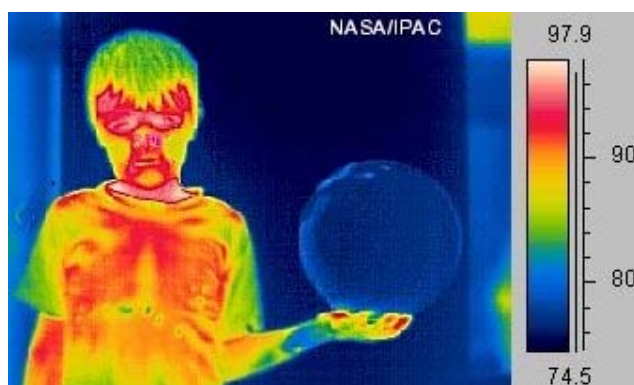
In other words, radiation can take place in a \_\_\_\_\_.

Radiation is \_\_\_\_\_  
\_\_\_\_\_.

In radiation, the source of thermal energy transmits energy in the form of waves. These waves make up the electromagnetic spectrum and are known as \_\_\_\_\_. When absorbed, the energy of the waves transforms into the thermal energy of the body.



**Think!**



The picture shows a infra-red scan of a boy holding a ball, explain why certain parts of him emit more infra red radiation than the rest.

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## Emission of Radiation

It is found that the following affects the rate of infrared radiation from a body:

- a. Colour and texture of surface

	Black and Dull surfaces	White and Shiny Surfaces
Good Absorber of Radiation		
Good Emitter of Radiation		
Poor Absorber of Radiation		
Poor Emitter of Radiation		

- b. Surface temperature

Higher surface temperature → \_\_\_\_\_

- c. Surface area

Larger Surface Area → \_\_\_\_\_

## Applications of radiation

- a. Teapots



Why are tea pots made with shiny material?

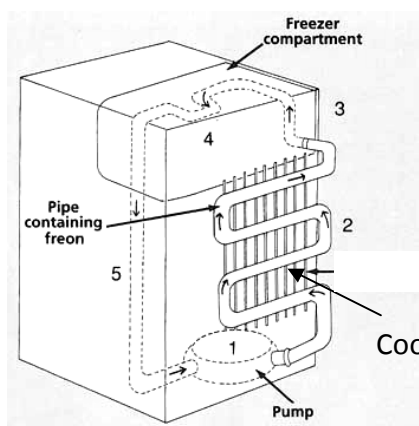
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- b. Cooling fins of refrigerator



Why are the cooling fins of the refrigerator black in colour?

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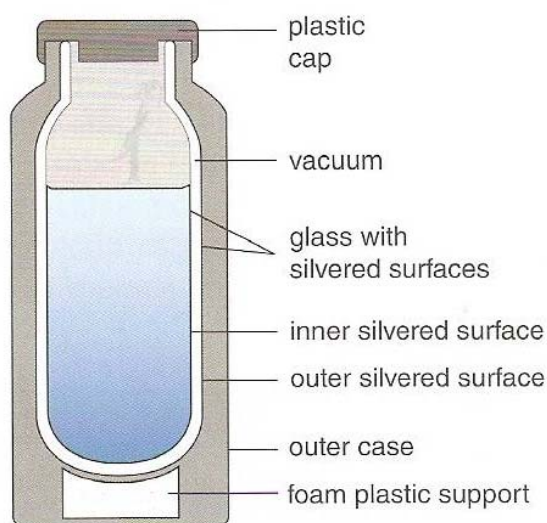
## NOTES 8.4

### LESSON OBJECTIVES

At the end of the lesson, you will be able to:

- Explain how heat is retained in the vacuum flask.

A vacuum flask is designed to keep hot liquids hot and cold liquids cold. Essentially, we need to reduce the transfer of thermal energy by conduction, convection and radiation.



### Key features of flask and how they reduce heat losses

Features	Reduce heat losses by
Plastic cap	
Vacuum	
Inner and outer silvered surface	
Foam Plastic support	